

App. No. 09/763,282

Response mailed March 14, 2005

Re: Office Action mailed January 14, 2005

### **REMARKS**

In response to the Office Action mailed January 14, 2005, the Applicant respectfully requests that the Examiner consider the following remarks. The remarks address the Examiner's 'Response to Arguments' section of the Office Action. Claims 19-31, 34-65, and 82 are unchanged and remain pending in the application. The Applicant respectfully requests further examination and reconsideration of the application in light of the remarks.

### **Withdrawal of Rejection of Claims Under 35 U.S.C. § 112**

The Applicant appreciates the Examiner's withdrawal of the claim rejections under 35 USC § 112 as described in the Office Action mailed on April 22, 2004, in view of the amendment filed on October 25, 2004.

### **Election/ Restrictions**

The Applicant appreciates the Examiner's acknowledgement of the Applicant's election of Group II, claims 19-31, 34-72, 81, and 82 in the amendment filed on October 25, 2004.

### **Rejections of Claims Under 35 U.S.C. § 103(a)**

The Examiner rejected claims 19-27, 29-31, 34-65, and 82 under 35 U.S.C. §

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103(a) as being unpatentable over Gamson (US-PAT-NO: 3,684,697) in view of DE19540780A1. Claim 28 was also rejected under 35 U.S.C. § 103(a) as being unpatentable over Gamson (US-PAT-NO: 3,684,697) in view of DE 19540780A1 as applied to claim 25 above, and further in view of Yan (US-PAT-NO: 4,096,097). The Applicant respectfully traverses these rejections.

**Claims 19-27, 29-31, 34-65, and 82 are NOT obvious over Gamson (US-PAT-NO: 3,684,697) in view of DE 19540780A1.** The Applicant respectfully submits that the current invention (particularly independent claim 19) distinguishes over the respective contributions made by the cited references separately, and the combination suggested by the Examiner. That is, the current invention distinguishes over (1) the sponge coke production of Gamson, (2) the quenching system of DE19540780A1, and (3) their combination as suggested by the Examiner.

Gamson (US-PAT-NO: 3,684,697): Gamson teaches a method for achieving sponge coke in a delayed coking process, but uses substantially different methods (vs. the current invention) to produce a significantly different sponge coke (with different VCM characteristics) for a different purpose or use. The current invention distinguishes over Gamson in the following regards: (1) Gamson teaches methods to produce sponge coke suitable for the manufacture of carbon electrodes of the aluminum industry.

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However, this sponge coke is typically unsuitable for the addition of desirable chemical compounds in the quench portion of the thermal cracking process of the current invention. (2) Gamson does NOT teach further increasing the VCM levels, porosity, and adsorption characteristics above and beyond traditional, sponge coke; (3) Gamson does NOT teach methods (see claims 23-24) that include the addition of certain 'additives' to affect the sponge coking mechanisms, NOT the asphaltene concentration in the feed; (4) Gamson teaches methods that reduce the capacity and upgrading capabilities of delayed coking to achieve sponge coke production, and the current invention does not; and (5) Gamson does NOT teach producing a porous, sponge coke for the addition of other chemical compounds (e.g., sulfur adsorbents) for the specific purpose of improving the pet coke's combustion characteristics, ash characteristics, and/or environmental impacts, as described in independent claim 19. The following paragraphs provide further discussion to support these arguments.

Essentially, Gamson uses a feedstock dilution method of the delayed coking process to produce sponge coke suitable for the manufacture of graphite and carbon electrodes used in the aluminum industry. Hydrocarbon bottoms which have low asphaltenes contents (e.g., below about 8 %) are added to coking feedstocks with asphaltenes content above about 13 % (as measured by ASTM D2006). Gamson teaches that the dilution of the asphaltenes content below 13 % (on its own) is sufficient to effect a change of coke crystalline structure from shot coke production to sponge

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coke production. However, Gamson does not teach that an asphaltene content of less than 13% in the coking feedstock can still form shot coke (desolution of asphaltene and resins) if there are not sufficient levels of hydrocarbons (e.g., heavy aromatics) that behave as solvents for the asphaltene. As noted in the current invention, the ratio of asphaltene to other aromatics in the coker feed is more critical to the formation of sponge coke than the absolute weight content of asphaltene in the coker feed. Also, Gamson does not teach the role of resins in shot coke formation and their impact on its dilution method. As described in the specification of the current invention, sponge coke is a broad classification of coke crystalline structure that can have varying degrees of density or porosity. In traditional delayed coking, even "sponge coke production" often contains a mixture of sponge coke and shot coke, sometimes with a substantial proportion of shot coke. Also, this invention describes the relevance of various chemical components of the feeds (aromatics, resins, and asphaltene) and other feed characteristics to the production of sponge coke (vs. shot coke or needle coke). Sponge coke production can be very difficult to achieve from heavier coker feedstocks at typical operating conditions of traditional, delayed coking, especially with feedstocks containing substantial levels of contaminants (e.g., sulfur, vanadium, etc.) that make the resulting pet coke unsuitable for the manufacture of carbon electrodes used in the aluminum industry. The resulting coke from these feeds is normally shot coke in traditional delayed coking and is only suitable as a very poor grade of fuel. The current invention

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goes well beyond the feedstock dilution of Gamson to achieve sponge coke production even for these very difficult feedstocks. The current invention teaches methods (primarily changes in traditional, operating conditions) to maintain the proper ratio of asphaltic coking to thermal (aromatics) coking to produce sponge coke preferentially over shot coke for even the most difficult process feeds. The methods of the current invention can produce sponge coke with greater porosity than traditional sponge coke, from process feedstocks that normally produce fuel grade, shot coke with traditional coking process operating conditions. The primary method controls the coke quality via changing traditional, thermal cracking process operating conditions; primarily reducing the coke drum temperature (e.g., lower heater outlet temperature and/or coking cycle quench). As such, the methods employed by Gamson are often not sufficient to produce sponge coke with these difficult feeds, particularly sponge coke that is suitable for the addition of other chemical compounds. Even with lighter feeds where Gamson is sufficient to produce sponge coke, the sponge coke, that is suitable for the manufacture of graphite and carbon electrodes used in the aluminum industry, is typically not suitable for adding desirable chemical compounds and does not improve the combustion characteristics, as described in the current invention. That is, this sponge coke typically does not have sufficient porosity and adsorption characteristics for the addition of desirable chemical compounds in the quench portion of the thermal cracking process of the current invention.

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Furthermore, Gamson's addition of such materials to the coker feed to reduce asphaltene content does not cause the resulting coke to have VCM amounts within the claimed ranges of this application nor improve the adsorption characteristics of the resulting coke above and beyond that of traditional, sponge coke. The Applicant respectfully submits that Gamson provides neither means nor incentive to produce a coke with VCM content outside the traditional range of 8–12 wt. % for pet coke. In the manufacture of graphite and carbon electrodes used in the aluminum industry, this type of sponge coke is calcined to remove excess VCM (e.g., greater than 0.5 wt. %) and further treated to change the crystalline structure and density characteristics of the pet coke. Thus, VCM content greater than 12 wt. % would be objectionable and counterproductive for the calcination process of this metallurgical coke (vs. fuel coke), and the porous quality of the sponge coke is not critical to the final product. Ones skilled in the art of delayed coking recognize that achieving sponge coke production, while maintaining specific VCM ranges can be even more challenging. The current invention teaches methods (primarily operating conditions) to increase VCM levels and adsorption characteristics above and beyond traditional, sponge coke.

Though the pet coke from the delayed coking process will have improved adsorption characteristics over shot coke, Gamson's resulting coke will not attain the improved adsorption characteristics of the current invention without employing the methods of the current invention. In contrast, the current invention specifically

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discusses these issues in its specification and clearly differentiates over Gamson in these regards. The current invention also teaches further increasing the porosity of the sponge coke by other process means. These means (see claims 23 and 24) also include the addition of certain 'additives' to affect the coking mechanisms, NOT the asphaltene concentration in the feed. For example, the uniform addition of 'additives' to the coke precursor material changes the coking mechanism via the roles of aromatics (e.g., asphaltic to thermal coking ratio) and/or hydrogen as described in the specification of the current invention.

Finally, the methods employed by Gamson often cause unnecessary, negative economic and capacity impacts on delayed coking units. That is, the dilution of the feed, with many of the diluent materials described by Gamson, cause a lower feed capacity for a given delayed coking process unit (particularly existing ones), and reduce the cost effectiveness of its upgrading efficiency. That is, the dilution of the coker feedstocks can push the process limits of the heater and fractionation sections of the delayed coker process units and reduce their upgrading capabilities. In contrast, the methods taught by the current invention achieve the objective of sponge coke production without a loss in unit throughput capacity or upgrading capabilities. In conclusion, Gamson is not even a reasonable, functional equivalent to the current invention due to all the shortcomings of Gamson, discussed above.

As noted by the Examiner, the "Gamson reference does not disclose adding at

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least one chemical compound to the coke in a coke-quenching portion of the thermal cracking process." As described above, Gamson does not even teach producing a porous, sponge coke suitable for the addition of other chemical compounds (e.g., sulfur adsorbents) for the specific purpose of improving the pet coke's combustion characteristics, ash characteristics, and/or environmental impacts. Instead, Gamson teaches the production of sponge coke with characteristics favorable for the manufacture of graphite and carbon electrodes used in the aluminum industry. In contrast, the current invention teaches various methods to uniformly distribute various selected chemical compounds within the porous sponge coke via the coke quench media to improve pet coke fuel properties, combustion characteristics, and environmental impacts from the combustion of the resultant modified coke. These methods provide the means to control the quality and quantity of the 'chemical compounds' integrated in the modified coke. In many cases, integration of these additives requires the increased porosity and improved adsorption characteristics of the coke (e.g., with feedstocks traditionally producing shot coke) created by the methods and process means of the present invention. Thus, the methods of the current invention to produce porous, sponge coke and further increase coke porosity and adsorption characteristics for the purpose of adding favorable chemical compounds (e.g., sulfur adsorbents) for fuel coke are distinguished over the coking feedstock dillution method of Gamson's expired patent to reduce asphaltenes content below



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about 13% and promote the production of sponge coke for the manufacture of graphite and carbon electrodes used in the aluminum industry. The current invention distinguishes over Gamson not only in methods, but also as a different purpose or new use. In independent claim 19 of the current invention, the claim language provides a step to "promote the production of sponge coke". An additional step is included for "Adding at least one chemical compound of predetermined quality and predetermined quantity to said porous sponge coke in a coke quenching portion of said thermal cracking process; Whereby said at least one chemical compound substantially improves the combustion characteristics, ash characteristics, or environmental impacts of said coke when used in a combustion process." Thus, the Applicant respectfully submits that this claim language distinguishes over the process disclosed by Gamson. Since the independent claim of the current invention is distinguished over Gamson, all claims are distinguished over Gamson. As noted by the Examiner, this shortcoming of Gamson requires the rejection to be based on a combination of prior art references, including the German patent DE 19540780A1.

DE 19540780A1: The Applicant respectfully submits that DE 19540780A1 teaches a method for quenching a different type of coke with an aqueous solution, and not within the thermal cracking process of this application nor for a similar purpose or use. The current invention distinguishes over DE 19540780A1 in the following regards:

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(1) DE 19540780A1 teaches a modified coke quench in certain coke plants that produce metallurgical coke from coal. This type of coke is substantially different from sponge, petroleum coke of this invention or Gamson, and is not suitable for integrating chemical compounds within its crystalline structure. In this operation, the quench sprays an aqueous solution on the external surface of the coke after being pushed from its coking vessel. In contrast, the current invention integrates at least one chemical compound within the porous crystalline structure of sponge, petroleum coke via pressurized cooling media that flows through the porous coke within the coking vessel of the current invention; (2) DE 19540780A1 does NOT teach a step of integrating at least one chemical compound within the coke structure during the quenching step of the thermal cracking process of this application; in fact, the chemical compounds in its specified quench solution do not even remain with the product coke; (3) DE 19540780A1 uses a specific quench solution (vs. those of the current invention) for a very different purpose: reducing environmental emissions from the coke quench in a very different coke quench application (i.e., production of metallurgical coke from coal) due to the use of biologically cleaned process water (vs. substantially improving the combustion characteristics, ash characteristics, and/or environmental impacts of said sponge coke when used in a combustion process as stated in independent claim 19 of the current invention); and (4) the methods described by DE 19540780A1 apparently do not teach the controlled integration of selected chemical compounds (e.g., sulfur

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adsorbents) via quenching petroleum coke within the quench step of the thermal cracking process of the current invention, as described in independent claim 19. The following paragraphs provide further discussions to support these arguments.

The Applicant respectfully submits that DE 19540780A1 does NOT teach or specify the type of coke quench operation in this referenced patent. However, the temperatures of the unquenched coke 700 – 1000 °C (i.e., 1292 – 1832 °F) in this referenced patent indicate that the coke being quenched is from a coal-coking process (i.e., commonly referred to as a “coking plant”), where coal is converted to coke suitable for blast furnace operation in the steel making industry. After closer review of the translated patent, this is confirmed in line 2 of ‘Page Two’: “...in the coking plants which use biologically-cleaned processed waste water for the preparation of cooling water...” (emphasis added). Further research of this process indicates that the coke quench normally takes place at a quenching station external to the coking vessel, after the coke is ‘pushed’ (vs. “coke deletion” in the translation) from the coke oven battery. In addition, this blast furnace coke has much different physical and chemical properties, including poor crystalline structure. As such, this different type of coke is not even petroleum coke, and this coking process is far different from the thermal cracking process of the current invention or the delayed coking process of Gamson. Consequently, the quench of DE 19540780A1 is definitely not within the quench step of the thermal cracking process of this application or the delayed coking process of

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Gamson, wherein coke temperatures prior to quench are typically in the range of 400 – 500 °C (i.e., 752 – 932 °F). Thus, the methods described in DE 19540780A1 do not teach the controlled injection of selected chemical compounds (e.g., sulfur adsorbents) via quenching coke within the quench portion of the thermal cracking process in the current invention.

Essentially, DE 19540780A1 teaches the use of a specific quench solution for the purpose of reducing emissions of organic impurities and sulfides from a specific quench process (e.g., open spraying of metallurgical coke derived from coal) that uses biologically-cleaned process water and waste water from the 'cooling circuit refreshment system' in a coal-coking plant. More specifically, DE 19540780A1 teaches a method for quenching coke with an aqueous salt solution containing specific concentrations of iron (II) and iron (III) ions and a monoester disodium salt of succinic acid with oxyethylenenonyl phenol. The resulting foamed suspension of water and air mixture from the coke is subjected to one or more steps of flow-through condensation and expansion, which causes the coagulation of organic impurities and the collection of these organic impurities with sulfide compounds and water droplets. Thus, the addition of the these chemicals in this quench is apparently for the purpose of coagulating organic impurities from biologically cleaned process water (used as quench water) to reduce environmental emissions of this particular quench process; NOT for the specific purpose of integrating at least one chemical compound for improving the pet coke's

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combustion characteristics, ash characteristics, and/or the environmental impacts of the combustion of this modified pet coke. In contrast, the claim language of independent claim 19 in this application states "Whereby said at least one chemical compound substantially improves the combustion characteristics, ash characteristics, or environmental impacts of said coke when used in a combustion process." The chemical compounds in the specific quench solution of DE 19540780A1 (i.e., monoester disodium salts of succinic acid with oxyethylenenonyl phenol and iron ions) would not be effective as a sulfur adsorbent nor have significant impacts on combustion or ash characteristics of the resulting coke due to their chemical nature, quality, and low concentration. The concentration of sodium salts in the pet coke that is required to react with the sulfur of 'fuel-grade' pet coke (for significant sulfur oxides reduction in the combustion process) is much greater than the concentration of sodium salts taught by DE 19540780A1. Thus, the Applicant respectfully submits this claim language distinguishes over the process disclosed by DE 19540780A1.

Furthermore, the Applicant respectfully submits that DE 19540780A1 does NOT teach the integration of chemical compounds within a porous crystalline structure of a sponge petroleum coke. As noted above, DE 19540780A1's blast furnace, metallurgical coke with very poor crystalline character is very different from sponge, petroleum coke of the current invention or Gamson. As such, DE 19540780A1's metallurgical coke is not suitable for the integration of chemical compounds in the

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current invention. In addition, the coke quench of DE 19540780A1 apparently sprays water on the exterior surface of the coke, and does NOT teach pressurizing quench media that flows through the coke in a contained vessel like the current invention. As such, DE 19540780A1 does NOT leave chemical compounds from the quench on the interior surface of the coke. In fact, the chemical compounds in its specified quench solution apparently do not even remain with the product coke, since these chemicals are essentially used for the "...chemical absorption and coagulation of the impurities in the vapor and water in the coking plants..." (emphasis added). As disclosed in this application, these types of chemical compounds described in DE 19540780A1 would be difficult to integrate within the porous coke within coke drums due to their large physical structure. In other words, quenching coke in a closed vessel that relies on a fluid flowing through macropores, mesopores, and micropores within the sponge coke is far different from quenching coke in other processes (e.g., quenching fluid flowing over crushed coke of unspecified crystalline structure). Language in independent claim 19 states "Adding at least one chemical compound of predetermined quality and predetermined quantity to said porous sponge coke in a coke quenching portion of said thermal cracking process; Whereby said at least one chemical compound substantially improves the combustion characteristics, ash characteristics, or environmental impacts of said coke when used in a combustion process." In this regard, the only way the addition of said at least one chemical compound can occur is if the chemical compound

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is adsorbed on the internal surface of the porous, sponge coke. As such, this claim language further distinguishes over the process disclosed by DE 19540780A1. Consequently, the Applicant respectfully submits the independent claims of the current invention distinguish over DE 19540780A1. Thus, all claims distinguish over DE 19540780A1.

In summary, DE 19540780A1 does not teach a step of integrating at least one chemical compound within the coke structure during the quenching step of the thermal cracking process of this application. In fact, the chemical compounds in its specified quench solution do not even remain with the product coke. Furthermore, DE 19540780A1 uses a specific quench solution (vs. those of the current invention) for a very different purpose: reducing environmental emissions from the coke quench on a specific metallurgical coke quench application due to the use of biologically cleaned process water (vs. substantially improving the combustion characteristics, ash characteristics, and/or environmental impacts of said sponge coke when used in a combustion process as stated in independent claim 19 of the current invention). Finally, the methods described by DE 19540780A1 apparently do not teach the controlled integration of selected chemical compounds (e.g., sulfur adsorbents) via quenching coke within the quench step of the thermal cracking process of the current invention. Consequently, the Applicant respectfully submits that the methods of the current invention which provide controlled integration of selected chemical compounds

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via quenching coke within the quench portion of the thermal cracking process in the current invention for the specific purpose of improving the pet coke's combustion characteristics and environmental impacts are distinguished over the quenching of coke with an aqueous solution of different types of salts in a different type of coke operation for a different purpose or use of DE 19540780A1. Furthermore, the claim language of the independent claim of the current invention distinguishes over DE 19540780A1. Consequently, all claims of the current invention distinguish over DE 19540780A1

Combination of Gamson (US-PAT-NO: 3,684,697) and DE 19540780A1: The Applicant respectfully submits that the combination suggested by the Examiner would not be obvious to one skilled in the art. The combination of the production of sponge coke via Gamson (US-PAT-NO: 3,684,697) and the coke quench system with aqueous salt solutions of DE 19540780A1 is submitted to be improper because this combination would not teach the claims of this invention. As discussed above, DE 19540780A1 does not add chemical compounds to the product coke and does not disclose any advantage in doing so (i.e., adding chemical compounds to the product coke vs. reducing environmental emissions of the quench process), particularly for the end-use of the resultant coke. Furthermore, neither Gamson nor DE 19540780A1 suggest such a combination, and one skilled in the art would have no reason to make such a combination. Gamson does not teach or suggest a thermal cracking process or method



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to produce a sponge coke and to add additional chemical compounds to improve coke combustion characteristics, ash characteristics, and environmental impacts. Likewise, DE 19540780A1 does not teach or suggest a controlled, uniform integration of desirable additives via the quench portion of the thermal cracking process of this invention. Furthermore, Gamson is apparently not even working with the same coking process or the same type of coke (e.g., petroleum coke vs. metallurgical coke from coal) as DE 19540780A1, which is definitely not pertaining to the quenching portion of the thermal cracking process of this invention or the delayed coking process of Gamson. Accordingly, there is no motivation in the prior art to combine the references as suggested by the Examiner, and the proposed combination of these references still does not teach or suggest every limitation of the present invention. Also, the Applicant respectfully submits that the combination of these referenced patents would NOT be obvious to ones skilled in the art, since the coke operation of DE 19540780A1, as stated above, is not even the same coke process as the delayed coking process of Gamson. Finally, the Applicant's own experience has demonstrated this combination is not obvious to ones skilled in the art. The Applicant is working with experienced coker process engineers at refineries that have been using coking feedstocks which normally produce shot coke with traditional coking operations of the prior art. None of them use the expired patented technology of Gamson to convert shot coke to sponge coke production. Yet, these coker process engineers have asked the Applicant to make this

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conversion and also inject the additives of the present invention. In addition, one coker process engineer has successfully tested principles of the current invention (with permission & assistance of the Applicant) to temporarily change from shot coke to sponge coke production in their commercial unit, while using a coking feedstock that normally produces shot coke with traditional coking operations of the prior art. Thus, this combination of references is clearly not obvious to ones skilled in the art.

Conclusion: The Applicant respectfully submits that the novel thermal cracking process options and methods of the current invention are (1) unobvious to one skilled in the art and (2) these distinctions of the present invention provide surprising and unexpected results and are patentable under Section 103 because the modified sponge coke of the current invention allows the integration of various desirable chemical compounds (e.g., sulfur adsorbents, high quality VCM, and oxygen-containing hydrocarbons) during the quench of the thermal cracking process (e.g., delayed coking) which can improve the coke's combustion characteristics, ash characteristics, and environmental impacts. Therefore, Gamson and DE 19540780A1 provide no motivation to combine or modify the references as suggested by the Examiner in order to arrive at the claimed invention. Only after the knowledge presented in the specification of the current invention (e.g., novel principles of how these chemical compounds improve the pet coke's combustion characteristics, ash characteristics, and

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environmental impacts) can the uniform integration of desirable chemical compounds in a porous coke crystalline structure produce the new and unexpected results of the current invention.

**Claim 28 is NOT obvious over Gamson (US-PAT-NO: 3,684,697) in view of DE19540780A1 and Yan (US-PAT-NO: 4,096,097).** The Applicant respectfully submits that the current invention (particularly claim 28) distinguishes over the respective contributions made by the cited references separately, and the combination suggested by the Examiner. That is, the current invention distinguishes over (1) the sponge coke production of Gamson, (2) the quenching system of DE19540780A1, (3) the sponge coke production and coke calcining process of Yan, and (4) their combination as suggested by the Examiner.

*Gamson (US-PAT-NO: 3,684,697):* The Applicant respectfully submits that Gamson (US-PAT-NO: 3,684,697) claims a method to promote the production of traditional, sponge coke in the delayed coking process, but does not teach the methods or additional limitations of this application. Furthermore, this reference patent does not teach the production of sponge coke for a similar purpose or use. Some or all of the specific arguments regarding Gamson in the first 103 section (i.e., rejection of claims 19-27, 29-31, 34-65, and 82) are also valid for this section concerning the rejection of

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claim 28. However, for the sake of brevity the key points of that discussion can be summarized as above. The current invention distinguishes over Gamson in the following regards: (1) Gamson teaches methods to produce sponge coke suitable for the manufacture of carbon electrodes of the aluminum industry. However, this sponge coke is typically unsuitable for the addition desirable chemical compounds in the quench portion of the thermal cracking process of the current invention; (2) Gamson does NOT teach further increasing the VCM levels, porosity, and adsorption characteristics above and beyond traditional, sponge coke; (3) Gamson does NOT teach methods (see claims 23 and 24) that include the addition of certain 'additives' to affect the sponge coking mechanisms, NOT the asphaltene concentration in the feed; (4) Gamson teaches methods that reduce the capacity and upgrading capabilities of delayed coking to achieve sponge coke production, and the current invention does not; and (5) Gamson does NOT teach producing a porous, sponge coke for the addition of other chemical compounds (e.g., sulfur adsorbents) for the specific purpose of improving the pet coke's combustion characteristics, ash characteristics, and/or environmental impacts, as described in independent claim 19. In contrast, the current invention specifically discusses these issues in its specification and clearly differentiates over Gamson in all these regards. Thus, the methods of the current invention to produce porous sponge coke from difficult, heavier feeds and add favorable chemical compounds (e.g., sulfur adsorbents) for fuel coke are distinguished over the coking

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feedstock dilution method of Gamson's expired patent to reduce asphaltenes content in lighter feeds below about 13% and promote the production of sponge coke suitable for the manufacture of graphite and carbon electrodes used in the aluminum industry. The current invention distinguishes over Gamson not only in methods, but also as a different purpose or new use. In independent claim 19 of the current invention, the claim language provides a step to "promote the production of sponge coke" (i.e., traditional, sponge coke). An additional step is included for "Adding at least one chemical compound of predetermined quality and predetermined quantity to said porous sponge coke in a coke quenching portion of said thermal cracking process; Whereby said at least one chemical compound substantially improves the combustion characteristics, ash characteristics, or environmental impacts of said coke when used in a combustion process." Thus, the Applicant respectfully submits that this claim language distinguishes over the process disclosed by Gamson. Since the independent claim of the current invention is distinguished over Gamson, all claims are distinguished over Gamson. As noted by the Examiner, this shortcoming of Gamson requires the rejection to be based on a combination of prior art references, including the German patent DE 19540780A1.

DE 19540780A1: The Applicant respectfully submits that DE 19540780A1 teaches a method for quenching coke with an aqueous solution, but not within the

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thermal cracking process of this application nor for a similar purpose or use. Some or all of the specific arguments regarding DE 19540780A1 in the first 103 section (i.e., rejection of claims 19-27, 29-31, 34-65, and 82) are also valid for this section concerning the rejection of claim 28. However, for the sake of brevity the key points of that discussion can be summarized as above. The current invention distinguishes over DE 19540780A1 in the following regards: (1) DE 19540780A1 teaches a modified coke quench in certain coke plants that produce metallurgical coke from coal. This type of coke is substantially different from sponge, petroleum coke of this invention or Gamson, and is not suitable for integrating chemical compounds within its crystalline structure. In this operation, the quench sprays an aqueous solution on the external surface of the coke after being pushed from its coking vessel. In contrast, the current invention integrates at least one chemical compound within the porous crystalline structure of sponge, petroleum coke via pressurized cooling media that flows through the porous coke within the coking vessel of the current invention; (2) DE 19540780A1 does NOT teach a step of integrating at least one chemical compound within the coke structure during the quenching step of the thermal cracking process of this application; in fact, the chemical compounds in its specified quench solution do not even remain with the product coke; (3) DE 19540780A1 uses a specific quench solution (vs. those of the current invention) for a very different purpose: reducing environmental emissions from the coke quench in a very different coke quench application (i.e., production of

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metallurgical coke from coal) due to the use of biologically cleaned process water (vs. substantially improving the combustion characteristics, ash characteristics, and/or environmental impacts of said sponge coke when used in a combustion process as stated in independent claim 19 of the current invention); and (4) the methods described by DE 19540780A1 apparently do not teach the controlled integration of selected chemical compounds (e.g., sulfur adsorbents) via quenching petroleum coke within the quench step of the thermal cracking process of the current invention, as described in independent claim 19. In contrast, the claim language of independent claim 19 in this application states "Adding at least one chemical compound of predetermined quality and predetermined quantity to said porous sponge coke in a coke quenching portion of said thermal cracking process; Whereby said at least one chemical compound substantially improves the combustion characteristics, ash characteristics, or environmental impacts of said coke when used in a combustion process." Consequently, the Applicant respectfully submits that the methods of the current invention (which include controlled integration of selected chemical compounds via coke quench for the specific purpose of improving the pet coke's combustion characteristics, ash characteristics, and/or environmental impacts) are distinguished over the quenching of coke with an aqueous solution of different types of salts in a different type of coke operation for a different purpose or use in DE 19540780A1. Furthermore, the claim language of the independent claims of the current invention

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distinguish over DE 19540780A1. Consequently, all claims of the current invention distinguish over DE 19540780A1.

Yan (US-PAT-NO: 4,096,097): The Applicant respectfully submits that Yan (US-PAT-NO: 4,096,097) teaches a method for the preferential formation of sponge coke (vs. shot coke) suitable for use in the manufacture of electrodes via improved grindability characteristics. As noted above in discussions of Gamson, sponge coke suitable for the manufacture of carbon electrodes for the aluminum industry (i.e., anode grade coke) is often not suitable for the addition of desirable chemical compounds within the sponge coke via the quench portion of the thermal cracking process of the current invention. Also noted above, the poorer quality feeds associated with fuel-grade, petroleum coke have characteristics that make them more difficult to achieve sponge coke production and make the resulting coke unsuitable for the manufacture of carbon electrodes in the aluminum industry. However, the Applicant incorporates the principles of this expired patent in the specification of the current invention in a novel combination of methods and "new use" for increasing the porosity and adsorption character of the coke to improve the ability to uniformly distribute desirable chemical compounds into the resultant modified coke for the specific purpose of improving the combustion characteristics, ash characteristics, and/or environmental impacts of the modified fuel coke, not the grindability characteristics for the manufacture of electrodes.



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In addition, Yan does not teach anything new with respect to the prior art of coke calcining. In many cases, excessive impurities prevent certain cokes from being calcined and used for the manufacture of electrodes in steel or aluminum production. In these situations, the additional step in Claim 25 (along with the increased porosity of the current invention) is used in the current invention to integrate reactive chemical compounds via the quenching process of the thermal cracking process of the current invention to remove excessive impurities (e.g., sulfur, nitrogen, and/or metals). After the excessive impurities have reacted to form removable compounds in this step, the resulting coke can be calcined (see Claim 28) using one of many calcining techniques. Thus, this additional step and others described above distinguish the current invention over the sponge coke production and coke calcining of Yan or other prior art.

Combination of Gamson, DE19540780A1, and Yan: The Applicant respectfully submits that the combination of Gamson, DE19540780A1, and Yan suggested by the Examiner would not be obvious to one skilled in the art. The combination of (1) the production of sponge coke by dilution of asphaltenes in the feed material via Gamson (US-PAT-NO: 3,684,697), (2) the coke quench system with aqueous salt solutions via DE 19540780A1, and (3) the addition of carbonaceous material to the feed material to promote sponge coke and the coke calcining via Yan (US-PAT-NO: 4,096,097) is submitted to be improper because this combination would not teach the claims of this

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invention. As discussed above, Gamson and Yan teach sponge coke production for better quality feeds that produce sponge coke suitable for the manufacture of carbon electrodes; not suitable for the addition of chemical compounds via the coke quench portion of the thermal cracking process of the current invention. Also, DE 19540780A1 does not add chemical compounds to the product coke and does not disclose any advantage in adding these chemical compounds for the end-use of the resultant coke. Furthermore, neither Gamson nor DE 19540780A1 nor Yan suggest such a combination, and one skilled in the art would have no reason to make such a combination, particularly since the combination suggested by the Examiner involves three very different processes in these prior art references. Gamson and Yan do not teach or suggest a thermal cracking process or method to produce a sponge coke and further increase the porosity and improve adsorption characteristics to add additional chemical compounds to improve coke combustion characteristics, ash characteristics, and/or environmental impacts. Likewise, DE 19540780A1 does not teach or suggest a controlled, uniform integration of desirable chemical compounds via the thermal cracking process quench. Furthermore, neither Gamson nor DE 19540780A1 nor Yan teach or suggest the potential use of increased porosity and improved adsorption characteristics of the coke produced to add chemical compounds to the coke in the quenching portion of the thermal cracking process. Finally, neither Gamson nor DE 19540780A1 nor Yan teach or suggest the potential addition of reactive chemicals to

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the coke in the quenching portion of the thermal cracking process to remove excessive impurities in the coke. Accordingly, there is no motivation in the prior art to combine the references as suggested by the Examiner, and the proposed combination of these references still does not teach or suggest every limitation of the present invention. Also, the Applicant respectfully submits that the combination of these referenced patents would NOT be obvious to ones skilled in the art, since the coke operation of DE 19540780A1, as stated above, and the coke calcining operation of Yan are very different coke operations versus the delayed coking process of Gamson. Finally, the Applicant's own experience has demonstrated this combination is not obvious to ones skilled in the art. The Applicant is working with experienced coker process engineers at refineries that have been using coking feedstocks which normally produce shot coke with traditional coking operations of the prior art. None of them use the expired patented technology of Gamson or Yan to convert shot coke to sponge coke production. Yet, these coker process engineers have asked the Applicant to make this conversion and also inject the additives of the present invention. In addition, one coker process engineer has successfully tested principles of the current invention (with permission & assistance of the Applicant) to temporarily change from shot coke to sponge coke production in their commercial unit, while using a coking feedstock that normally produces shot coke with traditional coking operations of the prior art. Thus, this combination of references is clearly not obvious to ones skilled in the art.

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Conclusion: The Applicant respectfully submits that the novel thermal cracking process options and methods of the current invention are (1) unobvious to one skilled in the art and (2) these distinctions of the present invention provide surprising and unexpected results and are patentable under Section 103 because the increased porosity and improved adsorption characteristics of the modified sponge coke (vs. traditional sponge coke) allow the integration of various desirable chemical compounds (e.g., sulfur adsorbents, high quality VCM, and oxygen-containing hydrocarbons) during the quench of the thermal cracking process (e.g., delayed coking) to improve the coke's combustion characteristics, ash characteristics, and/or environmental impacts. Therefore, Gamson, DE 19540780A1, and Yan provide no motivation to combine or modify the references as suggested by the Examiner in order to arrive at the claimed invention. Only after the knowledge presented in the specification of the current invention (e.g., novel principles of how these additives improve the pet coke's combustion characteristics, ash characteristics, and environmental controls) can the uniform integration of desirable additives in a porous coke crystalline structure produce the new and unexpected results of the current invention.

The Applicant respectfully submits that none of these cited references teaches the potential use of a modified pet coke to add reactive chemical compounds to the coke in the quenching portion of the thermal cracking process. The Applicant also

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respectfully submits that any combination of these cited references would not be obvious to one skilled in the art. The combination of sponge coke production by dilution of asphaltenes or addition of carbonaceous material in the feed material and a coke quench system with aqueous salt solutions is submitted to be improper because none of the cited references suggest such a combination, and one skilled in the art would have no reason to make such a combination. Furthermore, none of the cited references teach or suggest the potential use of increased porosity and improved adsorption characteristics of a modified coke to integrate various desirable chemical compounds (e.g., sulfur adsorbents, high quality VCM, and oxygen-containing hydrocarbons) during the quench portion of the thermal cracking process (e.g., delayed coking) for improving the coke's fuel properties, combustion characteristics, and environmental impacts. Accordingly, there is no motivation in the prior art to combine the references as suggested by the Examiner, and the proposed combination of these references still does not teach or suggest every limitation of the present invention. These distinctions of the present invention provide surprising and unexpected results and are patentable under Section 103 because the modified coke allow the integration of various reactive chemical compounds during the quench of the thermal cracking process (e.g., delayed coking) which can reduce excessive impurities to sufficiently low levels to allow the resulting coke to be used for electrodes in the manufacture of steel or aluminum. Therefore, none of the cited references provide any motivation to

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combine or modify the references as suggested by the Examiner in order to arrive at the claimed invention.

Since the novel physical features of the Applicant's modified petroleum coke provide these new and unexpected results over any reference, the Applicant submits that these new results indicate unobviousness and hence patentability. Therefore, the Applicant respectfully submits that no combination of the cited references can support the rejection of claim 28 under 35 U.S.C. § 103(a). Accordingly, the Applicant respectfully requests reconsideration and allowance of the present application with the existing claims.

### **Double Patenting**

Claims 19-31 and 82 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 3, and 19-21 of U.S. Patent No. 6,168,709 in view of DE 19540780A1. Claims 19-31, 34-65, and 82 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-56 of co-pending Application No. 09/556,132. The Applicant respectfully traverses these rejections.

The Applicant respectfully submits that the current invention is patentable over claims 1, 3, and 19-21 of U.S. Patent No. 6,168,709 in view of DE 19540780A1. The Applicant respectfully submits that Etter (US-PAT-NO: 6,168,709) teaches a method to

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promote the production of sponge coke in the thermal cracking process, but does not teach the additional limitations of this application. U.S. Patent No. 6,168,709 does NOT teach the addition of other chemical compounds (e.g., sulfur adsorbents) for the specific purpose of improving the pet coke's combustion characteristics, ash characteristics and/or environmental impacts. In independent claim 19 of the current invention, the claim language provides a step to "promote the production of sponge coke" (i.e., traditional, sponge coke). An additional step is included: "(c) Adding at least one chemical compound of predetermined quality and predetermined quantity to said porous sponge coke in a coke quenching portion of said thermal cracking process; Whereby said at least one chemical compound substantially improves the combustion characteristics, ash characteristics, or environmental impacts of said coke when used in a combustion process." Thus, the Applicant respectfully submits that this claim language distinguishes over the process disclosed by U.S. Patent No. 6,168,709. Furthermore, all claims of the current invention are distinguished over U.S. Patent No. 6,168,709, since the independent claims of the current invention are distinguished over U.S. Patent No. 6,168,709,

The Applicant respectfully submits that DE 19540780A1 teaches a method for quenching coke with an aqueous solution, but not within the thermal cracking process of this application nor for a similar purpose or use. Some or all of the specific arguments regarding DE 19540780A1 in the first 103 section (i.e., rejection of claims 1-

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3, 7, 8, 10-17, 19-29, & 33-56) are also valid for this section concerning the rejection of claims 19-31 and 82. However, for the sake of brevity the key points of that discussion can be summarized as above. The current invention distinguishes over DE 19540780A1 in the following regards: (1) DE 19540780A1 teaches a modified coke quench in certain coke plants that produce metallurgical coke from coal. This type of coke is substantially different from sponge, petroleum coke of this invention, and is not suitable for integrating chemical compounds within its crystalline structure. In this operation, the quench sprays an aqueous solution on the external surface of the coke after being pushed from its coking vessel. In contrast, the current invention integrates at least one chemical compound within the porous crystalline structure of sponge, petroleum coke via pressurized cooling media that flows through the porous coke within the coking vessel of the current invention, (2) DE 19540780A1 does NOT teach a step of integrating at least one chemical compound within the coke structure during the quenching step of the thermal cracking process of this application; in fact, the chemical compounds in its specified quench solution do not even remain with the product coke; (3) DE 19540780A1 uses a specific quench solution (vs. those of the current invention) for a very different purpose: reducing environmental emissions from the coke quench in a very different coke quench application (i.e., production of metallurgical coke from coal) due to the use of biologically cleaned process water (vs. substantially improving the combustion characteristics, ash characteristics, and/or environmental impacts of



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said sponge coke when used in a combustion process as stated in independent claim 19 of the current invention); and (4) the methods described by DE 19540780A1 apparently do not teach the controlled integration of selected chemical compounds (e.g., sulfur adsorbents) via quenching petroleum coke within the quench step of the thermal cracking process of the current invention, as described in independent claim 19. In contrast, the claim language of independent claim 19 in this application states "(c) Adding at least one chemical compound of predetermined quality and predetermined quantity to said porous sponge coke in a coke quenching portion of said thermal cracking process;" and "Whereby said at least one chemical compound substantially improves the combustion characteristics, ash characteristics, or environmental impacts of said coke when used in a combustion process." Consequently, the Applicant respectfully submits that the methods of the current invention, which include controlled integration of selected chemical compounds via coke quench for the specific purpose of improving the pet coke's combustion characteristics and environmental impacts, are distinguished over the quenching of coke with an aqueous solution of different types of salts in a different type of coke operation for a different purpose or use in DE 19540780A1. Furthermore, the claim language of the independent claims of the current invention distinguish over DE 19540780A1. Consequently, all claims of the current invention distinguish over DE 19540780A1.

Furthermore, neither of the cited references provides any motivation to combine

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or modify the references as suggested by the Examiner in order to arrive at the claimed invention. Therefore, the Applicant respectfully submits that claims 1, 3, and 19-21 of U.S. Patent No. 6,168,709 in view of DE 19540780A1 cannot support the rejection of claims 19-31 and 82 of the current invention under the obviousness-type double patenting doctrine.

Claims 19-31, 34-65, and 82 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-56 of co-pending Application No.09/556,132. The Applicant respectfully submits that claims 1-56 of co-pending Application No. 09/556,132 contain an added step to further increase the porosity and improve adsorption characteristics of the coke prior to adding other chemical compounds (e.g., sulfur adsorbents) in the coking quench portion of the thermal cracking process (e.g., delayed coking). That is, the independent claims (i.e., claims 1 and 17) of co-pending Application No.09/556,132 add further process means to increase porosity and improve adsorption characteristics of the coke prior to the coke quench. Thus, the Applicant respectfully submits that the independent claims of Application No.09/556,132 contain an additional step "(c) increasing porosity or improving adsorption characteristics of said sponge coke by a process means in said thermal cracking process;" and provides additional claim language in this regard "wherein the increased porosity or improved adsorption characteristics aid in the addition of said at least one chemical compound;" As a result

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of this added step and additional claim language, the independent claim of this application is distinguished over the independent claims of co-pending Application No.09/556,132. Hence, all the claims of this invention are distinguished over all claims of co-pending Application No.09/556,132.

Conclusion

The Applicant has distinguished claims 19-31, 34-65, and 82 over the cited references. Therefore, the Applicant respectfully submits that the present application is now in condition for allowance, and such action is earnestly requested. If the present application is still not in condition for allowance, your suggestions for modifications to put the present application in condition for allowance would be greatly appreciated.

Respectfully submitted,

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